

NATIONAL GEOSPATIAL-INTELLIGENCE AGENCY (NGA)
22.1 Small Business Innovation Research (SBIR) Phase I
Proposal Submission Instructions

INTRODUCTION

The National Geospatial-Intelligence Agency (NGA) has a responsibility to provide the products and services that decision makers, warfighters, and first responders need, when they need it most. As a member of the Intelligence Community and the Department of Defense, NGA supports a unique mission set. We are committed to acquiring, developing and maintaining the proper technology, people and processes that will enable overall mission success.

Geospatial intelligence, or GEOINT, is the exploitation and analysis of imagery and geospatial information to describe, assess and visually depict physical features and geographically referenced activities on the Earth. GEOINT consists of imagery, imagery intelligence and geospatial information.

With our unique mission set, NGA pursues research that will help guarantee the information edge over potential adversaries. Additional information pertaining to the National Geospatial-Intelligence Agency's mission can be obtained by viewing the website at <http://www.nga.mil/>.

Proposers responding to a topic in this BAA must follow all general instructions provided in the Department of Defense (DoD) SBIR Program BAA. NGA requirements in addition to or deviating from the DoD Program BAA are provided in the instructions below.

Specific questions pertaining to the administration of the SBIR Program and these proposal preparation instructions should be directed to:

National Geospatial-Intelligence Agency
Attn: SBIR Program Manager, RA, MS: S75-RA
7500 GEOINT Dr., Springfield, VA 22150-7500
Email: SBIR@nga.mil

PHASE I PROPOSAL GUIDELINES

The Defense SBIR/STTR Innovation Portal (DSIP) is the official portal for DoD SBIR/STTR proposal submission. Proposers are required to submit proposals via DSIP; proposals submitted by any other means will be disregarded. Detailed instructions regarding registration and proposal submission via DSIP are provided in the DoD SBIR Program BAA.

Technical Volume (Volume 2)

The technical volume is not to exceed 20 pages and must follow the formatting requirements provided in the DoD SBIR Program BAA. The Government will not consider pages in excess of the page count limitations. Number all pages of your proposal consecutively.

Content of the Technical Volume

Refer to the DoD SBIR Program BAA for detailed instructions on the content of the technical volume.

Cost Volume (Volume 3)

The Phase I Base amount must not exceed \$100,000 over a period of performance not exceeding 9 months.

Company Commercialization Report (CCR) (Volume 4)

Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD SBIR Program BAA for full details on this requirement. Information contained in the CCR will not be considered by NGA during proposal evaluations.

Supporting Documents (Volume 5)

In addition to the Volume 5 requirements listed in the DoD SBIR Program BAA, the vendor may submit supporting documents (Volume 5) but that material WILL NOT be reviewed by the evaluation team as part of the proposal evaluation. Items that may go into, not all inclusive, are additional cost proposal information, advocacy letters, etc.

PHASE II PROPOSAL GUIDELINES

Phase II proposals may only be submitted by Phase I awardees. Phase II is the demonstration of the technology found feasible in Phase I. All NGA SBIR Phase I awardees from this BAA will be allowed to submit a Phase II proposal for evaluation and possible selection. To minimize the gap between the Phase I and Phase II, it is suggested that the vendor submit their proposal during month 7 of the Phase I award.

The NGA SBIR Program is committed to minimizing the funding gap between Phase I and Phase II activities. Phase I awardees may submit a Phase II proposal without invitation; However, it is strongly encouraged that an UNCLASSIFIED Phase II proposal not be submitted until sufficient Phase I progress can be evaluated and assessed based on results of the Phase I proof-of-concept/feasibility study Work Plan. Therefore, it is highly recommended to submit your UNCLASSIFIED proposal 60 days prior to the end date of their Phase I contract in order to be considered for funding. All NGA SBIR Phase II proposals will receive a timely review.

Due to limited funding, the NGA SBIR Program reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded.

NGA typically provides a firm fixed price contract as a Phase II award. The type of contract is at the discretion of the Contracting Officer.

Initial Phase II proposals shall be limited to \$1,000,000 over a two-year period with a Period of Performance not exceeding 24 months.

Small businesses submitting a Phase II Proposal must use the DoD SBIR electronic proposal submission system (<https://www.dodsbirsttr.mil/submissions/>). This site contains step-by-step instructions for the preparation and submission of the Proposal Cover Sheets, the Company Commercialization Report, the Cost Volume, and how to upload the Technical Volume. For general inquiries or problems with proposal electronic submission, contact the DoD SBIR/STTR Help Desk at DoDSBIRSupport@reisystems.com.

The Phase II Technical Volume has a 40-page limit including: table of contents, pages intentionally left blank, references, letters of support, appendices, technical portions of subcontract documents (e.g., statements of work and resumes) and any attachments. Do not include blank pages, duplicate the electronically generated Cover Sheets or put information normally associated with the Technical Volume in other sections of the proposal as these will count toward the 40-page limit.

- **Proposal Cover Sheet (Volume 1):** The Cover Sheet must include a brief technical abstract of no more than 200 words that describes the proposed R&D project with a discussion of anticipated benefits and potential commercial applications. Do not include proprietary or classified information in the Proposal Cover Sheet. If your proposal is selected for award, the technical abstract and discussion of anticipated benefits may be publicly released.

- **Format of Technical Volume (Volume 2):** The Technical Volume must be a single Portable Document Format (PDF) file, including graphics. Perform a virus check before uploading the Technical Volume file. If a virus is detected, it may cause rejection of the proposal. Do not lock or encrypt the uploaded file. Do not include or embed active graphics such as videos, moving pictures, or other similar media in the document. The length of each part of the technical volume is limited to 40 pages. The Government will not consider pages in excess of the page count limitations. Number all pages of your proposal consecutively. Font size should not be smaller than 12 pitch Times New Roman font, with at least a one-inch margin on top, bottom, and sides, on 8½” by 11” paper. The header on each page of the Technical Volume should contain your company name, topic number, and proposal number assigned by DSIP when the Cover Sheet was created. The header may be included in the one-inch margin.
 - (1) Significance of the Problem. Define the specific technical problem or opportunity addressed and its importance.
 - (2) Phase II Technical Objectives. Enumerate the specific objectives of the Phase II work, and describe the technical approach and methods to be used in meeting these objectives.
 - (3) Phase II Statement of Work. The statement of work should provide an explicit, detailed description of the Phase II approach, indicate what is planned, how and where the work will be carried out, a schedule of major events and the final product to be delivered. The methods planned to achieve each objective or task should be discussed explicitly and in detail. This section should be a substantial portion of the total proposal. Include how and where the work will be carried out, a schedule of major events and the final product to be delivered. The methods planned to achieve each objective or task should be discussed explicitly and in detail.
 - (4) Section 508 Compliance: The contractor shall ensure that all systems, hardware, software, software engineering, and information technology associated with this effort is made in a manner that is accessible for people with the standards for people with disabilities as directed in the NGA Instruction 8400.4 and Section 508 of the Rehabilitation Act of 1973 as amended in 1998 (Section 508). Specifically, all Information and Communications Technology (ICT) associated with this contract, may use the Web Content Accessibility Guidelines (WCAG) 2.1 to comply with the Section 508 or use alternative designs or technologies which result in substantially equivalent or greater access to and use of the product for people with disabilities. Furthermore, the contractor shall pursue human centered design and usability guidelines in order to ensure that all services associated with this Topic Area are accessible by as many users as possible and as a means to drive modernization, innovation, and enhance mission support. **As part of the vendor’s proposal, the vendor should include an outline specifically how Section 508 compliance will be achieved in the design of the ICT product. The proposal for Phase 2 should provide an explicit, detailed description of the approach, indicate what is planned, how and where the work will be carried out, a schedule of major events, how the solution will be Section 508 Compliant, and the final product to be delivered. The methods planned to achieve each objective or task should be discussed explicitly and in detail. If a determination is made that a Section 508 exception request is justified, the rationale for the exception request must be made and submitted as a part of the proposal.**
 - (5) Related Work. Describe significant activities directly related to the proposed effort, including any conducted by the Principle Investigator (PI), the proposer, consultants or others. Describe how these activities interface with the proposed project and discuss any planned coordination with outside sources. The proposal must persuade reviewers of the proposer's awareness of the state of the art in the specific topic. Describe previous work not directly related to the proposed effort but similar. Provide the following: (1) short

- description, (2) client for which work was performed (including individual to be contacted and phone number) and (3) date of completion.
- (6) Relationship with Future Research or Research and Development. State the anticipated results of the proposed approach if the project is successful. ii. Discuss the significance of the Phase II effort in providing a foundation for Phase III research and development or commercialization effort.
 - (7) Key Personnel. Identify key personnel who will be involved in the Phase II effort including information on directly related education and experience. A concise resume of the PI, including a list of relevant publications (if any), must be included. All resumes count toward the page limitation.
 - (8) Foreign Citizens. Identify any foreign nationals you expect to be involved on this project.
 - (9) Facilities/Equipment. Describe available instrumentation and physical facilities necessary to carry out the Phase I effort. Items of equipment to be purchased (as detailed in the cost proposal) shall be justified under this section. If proposing to perform classified activities during the period of performance you need to provide the following: 1) Will the information include controlled unclassified information (CUI) and; 2) What unclassified IT systems will be required.
 - (10) Subcontractors/Consultants. Involvement of a university or other subcontractors or consultants in the project may be appropriate. If such involvement is intended, it should be identified and described according to the Cost Breakdown Guidance. Please refer to section 4.2 of this BAA for detailed eligibility requirements as it pertains to the use of subcontractors/consultants.
 - (11) Prior, Current or Pending Support of Similar Proposals or Awards. If a proposal submitted in response to this is substantially the same as another proposal that was funded, is now being funded, or is pending with another Federal Agency, or another or the same DoD Component, you must reveal this on the Proposal Cover Sheet and provide the following information: a) Name and address of the Federal Agency(s) or DoD Component to which a proposal was submitted, will be submitted, or from which an award is expected or has been received. b) Date of proposal submission or date of award. c) Title of proposal. d) Name and title of the PI for each proposal submitted or award received. e) Title, number, and date of BAA(s) or solicitation(s) under which the proposal was submitted, will be submitted, or under which award is expected or has been received. f) If award was received, state contract number. g) Specify the applicable topics for each proposal submitted or award received. Note: If this does not apply, state in the proposal "No prior, current, or pending support for proposed work."
 - (12) Commercialization Strategy. NGA is equally interested in dual use commercialization of SBIR/STTR projects that result in products sold to the U.S. military, the private sector market, or both. NGA expects explicit discussion of key activities to achieve this result in the commercialization strategy part of the proposal. The Technical Volume of each Direct to Phase I proposal must include a commercialization strategy section. The Phase I commercialization strategy shall not exceed 5 pages. The commercialization strategy should include the following elements:
 - a) Problem or Need Statement. Briefly describe what you know of the problem, need, or requirement, and its significance relevant to a Department of Defense application and/or a private sector application that the SBIR/STTR project results would address.
 - b) Description of Product(s) and/or System Application(s). Identify the commercial product(s) and/or DoD system(s), or system(s) under development, or potential new system(s). Identify the potential DoD end users, Federal customers, and/or private sector customers who would likely use the technology.

- c) Business Model(s)/Procurement Mechanism(s). Discuss your current business model hypothesis for bringing the technology to market. Describe plans to license, partner, or self-produce your product. How do you plan to generate revenue? Understanding NGA's goal of creating and sustaining a U.S. military advantage, describe how you intend to develop your product and supply chains to enable this differentiation.
 - d) Target Market. Describe the market and customer sets you propose to target, their size, their growth rate, and their key reasons they would consider procuring the technology. Describe competing technologies existent today on the market as well as those being developed in the lab.
 - e) Funding Requirements. Describe your company's funding history. How much external financing have you raised? Describe your plans for future funding sources (internal, loan, angel, venture capital, etc.).
 - f) Commercialization Risks. Describe the major technology, market and team risks associated with achieving successful transition of the NGA funded technology. NGA is not afraid to take risks but we want to ensure that our awardees clearly understand the risks in front of them.
 - g) Expertise/Qualifications of Team/Company Readiness. Describe the expertise and qualifications of your management, marketing/business development and technical team that will support the transition of the technology from the prototype to the commercial market and into government operational environments. Has this team previously taken similar products/services to market? If the present team does not have this needed expertise, how do you intend to obtain it? What is the financial history and health of your company (e.g., availability of cash, profitability, revenue growth, etc.)?
- **Format of Cost Volume (Volume 3):** The Cost Volume (and supporting documentation) DOES NOT count toward the page limit of the Technical Volume. Some items in the Cost Breakdown Guidance below may not apply to the proposed project. If such is the case, there is no need to provide information on each and every item. ALL proposed costs should be accompanied by documentation to substantiate how the cost was derived. For example, if you proposed travel cost to attend a project-related meeting or conference, and used a travel website to compare flight costs, include a screen shot of the comparison. Similarly, if you proposed to purchase materials or equipment, and used the internet to search for the best source, include your market research for those items. You do not necessarily have to propose the cheapest item or supplier, but you should explain your decision to choose one item or supplier over another. It's important to provide enough information to allow contracting personnel to understand how the proposer plans to use the requested funds. If selected for award, failure to include the documentation with your proposal will delay contract negotiation, and the proposer will be asked to submit the necessary documentation to the Contracting Officer to substantiate costs (e.g., cost estimates for equipment, materials, and consultants or subcontractors). It is important to respond as quickly as possible to the Contracting Officer's request for documentation. Cost Breakdown Guidance:
 - List all key personnel by name as well as by number of hours dedicated to the project as direct labor.
 - Special tooling and test equipment and material cost may be included. The inclusion of equipment and material will be carefully reviewed relative to need and appropriateness for the work proposed. The purchase of special tooling and test equipment must, in the opinion of the Contracting Officer, be advantageous to the Government and should be related directly to the specific topic. These may include such items as innovative instrumentation and/or automatic test equipment. Title to property furnished by the Government or acquired with Government funds will be vested with NGA; unless it is

determined that transfer of title to the contractor would be more cost effective than recovery of the equipment by NGA.

- Cost for travel funds must be justified and related to the needs of the project.
- Cost sharing is permitted for proposals under this announcement; however, cost sharing is not required nor will it be an evaluation factor in the consideration of a proposal.
- All subcontractor costs and consultant costs must be detailed at the same level as prime contractor costs in regard to labor, travel, equipment, etc. Provide detailed substantiation of subcontractor costs in your cost proposal. The Supporting Documents Volume (Volume 5) may be used if additional space is needed. For more information about cost proposals and accounting standards, see the DCAA publication titled “Audit Process Overview – Information for Contractors” available at: <http://www.dcaa.mil>.
- **Company Commercialization Report (Volume 4):** See DoD SBIR Instructions on Company Commercialization Report. This material WILL NOT be reviewed by the evaluation team as part of the proposal evaluation.
- **Supporting Documents (Volume 5):** The vendor may submit supporting documents (Volume 5) but that material WILL NOT be reviewed by the evaluation team as part of the proposal evaluation. Items that may go into, not all inclusive, are additional cost proposal information, Completed Form SF326, advocacy letters, etc.
- **Fraud, Waste and Abuse Training (Volume 6):** See DoD SBIR Instructions on Fraud, Waste and Abuse Training. This material WILL NOT be reviewed by the evaluation team as part of the proposal evaluation.

Selection of Phase II proposals will be in accordance with the evaluation procedures and criteria discussed in this BAA (refer to Section 6.0 of the BAA). As part of subfactor c in the evaluation criteria, the vendor will be evaluated on how it addresses the following five questions on the overall commercialization strategy:

- (1) What is the first product that this technology will go into?
- (2) Who will be the customers, and what is the estimated market size?
- (3) How much money will be needed to bring the technology to market, and how will that money be raised?
- (4) Does the company contain marketing expertise and, if not, how will that expertise be brought into the company?
- (5) Who are the proposing firm’s competitors, and what is the price and/or quality advantage over those competitors?

A work breakdown structure that shows the number of hours and labor category broken out by task and subtask, as well as the start and end dates for each task and subtask, shall be included.

Phase II contracts shall include a requirement to produce a monthly status and financial reports, an interim report not later than 12 months after contract award, a prototype demonstration not later than 23 months after contract award and a final report not later than 24 months after contract award. These reports shall include the following sections:

- A summary of the results of the Phase II research to date
- A summary of the Phase II tasks not yet completed with an estimate of the completion date for each task
- A statement of potential applications and benefits of the research.
- A summary of any risks or issues

The interim and final report shall be prepared single spaced in 12 pitch Times New Roman font, with at least a one-inch margin on top, bottom, and sides, on 8½” by 11” paper. The pages shall be numbered.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)

NGA will not provide any TABA.

EVALUATION AND SELECTION

All proposals will be evaluated in accordance with the evaluation criteria listed in the DoD SBIR Program BAA. Selection of Phase I proposals will be in accordance with the evaluation procedures and criteria discussed in this BAA. As part of subfactor c in the evaluation criteria, the vendor will be evaluated on how it addresses the following five questions on the overall commercialization strategy:

- (1) What is the first product that this technology will go into?
- (2) Who will be the customers, and what is the estimated market size?
- (3) How much money will be needed to bring the technology to market, and how will that money be raised?
- (4) Does the company contain marketing expertise and, if not, how will that expertise be brought into the company?
- (5) Who are the proposing firm’s competitors, and what is the price and/or quality advantage over those competitors?

Proposals not conforming to the terms of this BAA, and unsolicited proposals, will not be considered. Awards are subject to the availability of funding and successful completion of contract negotiations.

The NGA SBIR Program reserves the right to limit awards under any topic, and only those proposals of superior scientific and technical quality in the judgment of the technical evaluation team will be funded. The offeror must be responsive to the topic requirements, as solicited.

Proposing firms will be notified of selection or non-selection status for a Phase I award within 90 days of the closing date of the BAA. The individual named as the Corporate Official on the Proposal Cover Sheet will receive an email for each proposal submitted from the Government Contracting Officer/Specialist with their official notification of proposal selection or non-selection. The notices will be binned into 3 categories: (1) proposals selected for award, (2) proposals selected for award, if additional funding becomes available, and (3) proposals not selected for award. Proposals with the award designation of ‘Award if Additional Funding Becomes Available’ will receive consideration for award 12 months from the BAA close date. An unsuccessful offeror has 3 days after notification that its proposal was not selected to submit a written request for a debriefing to the Contracting Officer (CO). Those offerors who get their written request in within the allotted timeframe above will be provided a debriefing.

Refer to the DoD SBIR Program BAA for procedures to protest the Announcement. As further prescribed in FAR 33.106(b), FAR 52.233-3, Protests after Award should be submitted to: Viphalac Dickover at Viphalac.C.Dickover@nga.mil.

AWARD AND CONTRACT INFORMATION

Federally Funded Research and Development Contractors (FFRDC) and other government contractors, whom have signed Non-Disclosures Agreements, may be used in the evaluation of your proposal. NGA typically provides a firm fixed price payable milestone contract for Phase I awards. The type of contract is at the discretion of the Contracting Officer.

Phase I contracts will include a requirement to produce monthly status reports, a more detailed interim report not later than 7 months after award, a final report no later than 9 months after award and any

software/algorithms/documentation from items developed in Phase I. These reports shall include the following sections:

- A summary of the results of the Phase I research to date
- A summary of the Phase I tasks not yet completed, with an estimated completion date for each task
- A statement of potential applications and benefits of the research.
- A summary of any risks or issues

The interim report (draft final report) and final report shall be prepared single spaced in 12 pitch Times New Roman font, with at least a one-inch margin on top, bottom, and sides, on 8½" by 11" paper. The pages shall be numbered.

ADDITIONAL INFORMATION

USE OF FOREIGN NATIONALS

Due to the nature of our business, only US Nationals are permitted to work on NGA topics, unless the vendor proposes the work as Fundamental Research and indicates it as such in the proposal. The use of non-US National on a NGA contract is PROHIBITED, unless the work is scoped as Fundamental Research. If the effort is Fundamental Research, the PI must be a US National. ALL offerors proposing to use non-US Nationals (which has not been determined as Fundamental Research) on the effort will be ineligible for award. This includes the use at universities or any other subcontractor. In the event it is determined to be Fundamental Research, non-US Nationals will be ineligible to receive controlled unclassified information as described below.

CONTROLLED UNCLASSIFIED INFORMATION (CUI)

Controlled Unclassified Information (CUI) is information that requires safeguarding or dissemination controls pursuant to and consistent with applicable law, regulations, and government-wide policies but is not classified under Executive Order 13526 or the Atomic Energy Act, as amended.

Executive Order 13556 "Controlled Unclassified Information" (the Order), establishes a program for managing CUI across the Executive branch and designates the National Archives and Records Administration (NARA) as Executive Agent to implement the Order and oversee agency actions to ensure compliance. The Archivist of the United States delegated these responsibilities to the Information Security Oversight Office (ISOO).

32 CFR Part 2002 "Controlled Unclassified Information" was issued by ISOO to establish policy for agencies on designating, safeguarding, disseminating, marking, decontrolling, and disposing of CUI, self-inspection and oversight requirements, and other facets of the Program. The rule affects Federal executive branch agencies that handle CUI and all organizations (sources) that handle, possess, use, share, or receive CUI—or which operate, use, or have access to Federal information and information systems on behalf of an agency.

During performance of this contract, if the government provides the vendor a dataset that is not publicly released, the vendor must be CUI Compliant to receive it. For more information on this compliance please see DFARS Clause 252.204-7012, NIST Special Publication SP 800-171 and the National Archives and Records Administration (NARA) website (<https://www.archives.gov/cui/about>).

CERTIFICATE PERTAINING TO FOREIGN INTERESTS

Offers must submit a SF-328 in Volume 5 in order to be considered for award. If after review of the form, the offeror may be found ineligible for award if the offerors foreign interest are found to be

unacceptable. The form can be found at <https://www.gsa.gov/forms-library/certificate-pertaining-foreign-interests>.

DISCLOSURE OF INFORMATION

(a) The Contractor shall not release to anyone outside the Contractor's organization any unclassified information, regardless of medium (e.g., film, tape, document), pertaining to any part of this contract or any program related to this contract, unless-

(1) The Contracting Officer has given prior written approval;

(2) The information is otherwise in the public domain before the date of release; or

(3) The information results from or arises during the performance of a project that involves no covered defense information (as defined in the clause at DFARS 252.204-7012, Safeguarding Covered Defense Information and Cyber Incident Reporting) and **has been scoped and negotiated by the contracting activity with the contractor and research performer and determined in writing by the contracting officer to be fundamental research* (which by definition cannot involve any covered defense information)**, in accordance with National Security Decision Directive 189, National Policy on the Transfer of Scientific, Technical and Engineering Information, in effect on the date of contract award and the Under Secretary of Defense (Acquisition, Technology, and Logistics) memoranda on Fundamental Research, dated May 24, 2010, and on Contracted Fundamental Research, dated June 26, 2008 (available at DFARS PGI 204.4).

(b) Requests for approval under paragraph (a)(1) shall identify the specific information to be released, the medium to be used, and the purpose for the release. The Contractor shall submit its request to the Contracting Officer at least 10 business days before the proposed date for release.

(c) The Contractor agrees to include a similar requirement, including this paragraph (c), in each subcontract under this contract. Subcontractors shall submit requests for authorization to release through the prime contractor to the Contracting Officer.

***Note: This must be negotiated prior to award of the contract. A request for determination after award will not be entertained and will result in the clause being pushed down to all subcontracts. Non-performance could result in cancelation of contract.**

5X252.204-7000-90 PUBLIC RELEASE OF INFORMATION

(a) Except as provided in paragraph (b) of this clause, information pertaining to this contract shall not be released to the public unless authorized by the Contracting Officer in accordance with DFARS 252.204-7000, Disclosure of Information. Requests for approval to release information pertaining to this contract shall be submitted to the Contracting Officer by means of NGA Form 5230-1, National Geospatial-Intelligence Agency Request for Clearance for Public Release.

(b) The contractor may provide past performance information regarding this contract, without Contracting Officer approval, to the Office of the Director of National Intelligence (ODNI), the Central Intelligence Agency (CIA), the National Reconnaissance Office (NRO), the National Security Agency (NSA), the Defense Intelligence Agency (DIA), and NGA to support source selections at those agencies. The contractor is responsible for the proper classification and handling of such information and shall provide a copy of the information provided to the Contracting Officer.

5X52.227-9000 UNAUTHORIZED USE OF NGA NAME, SEAL AND INITIALS

(a) As provided in 10 U.S.C. Section 425, no person may, except with the written permission of the Director, National Geospatial-Intelligence Agency, knowingly use the words "National Geospatial-Intelligence Agency", National Imagery and Mapping Agency" or "Defense Mapping Agency", the

initials “NGA”, “NIMA” or “DMA”, the seal of the National Geospatial-Intelligence Agency, National Imagery and Mapping Agency or the Defense Mapping Agency, or any colorable imitation of such words, initials, or seal in connection with any merchandise, retail product, impersonation, solicitation, or commercial activity in a manner reasonably calculated to convey the impression that such is approved, endorsed, or authorized by the Director, NGA.

(b) Whenever it appears to the U.S. Attorney General that any person is engaged or about to engage in an act or practice which constitutes or will constitute conduct prohibited by paragraph (a), the Attorney General may initiate a civil proceeding in a district court of the United States to enjoin such act or practice. Such court shall proceed as soon as practicable to hearing and determination of such action and may, at any time before such final determination, enter such restraining orders or prohibition, or take such other action as is warranted, to prevent injury to the United States, or to any person or class of persons whose protection the action is brought.

NGA SBIR 22.1 Phase I Topic Index

OSD221-001	Scene Geometry Aided Automatic Target Recognition (ATR) for Radar
OSD221-002	Automatic Labeling of Multiple Target Synthetic Aperture Radar (SAR) Imagery for Automatic Target Recognition (ATR)
OSD221-003	Rapid Object Detector Development from Limited Labelled Data

OSD221-001 TITLE: Scene Geometry Aided Automatic Target Recognition (ATR) for Radar

OUSD (R&E) MODERNIZATION PRIORITY: Artificial intelligence/machine learning (AI/ML), autonomy

TECHNOLOGY AREA(S): Information systems, sensors, electronics

OBJECTIVE: Develop and demonstrate synthetic aperture radar (SAR) ATR that reduces false alarm rates by incorporating modern artificial intelligence and geometry of the imaged area.

DESCRIPTION: The focus of this research incorporates geometry (building, tree, and road networks, etc.) of the imaging scene for radar ATR so that false alarms can be reduced. When an area of interest has been interrogated with SAR, the imagery includes the targets' signature, layover, and signatures of surrounding objects. All of the unwanted signatures (other than the targets' signature) contribute to false alarms. Hence, the goal of this research is to investigate novel radar ATR that reduces false alarms.

Radar ATR technologies have evolved over time from one-dimensional signal (range profile) to three-dimensional (3D) signal (i.e., 3D imagery) or even four-dimensional information. ATR has also evolved from a template-based approach to modern AI/ML—that is, deep learning—based recognition. During ATR technology evolution, we have also seen significant improvement in classification accuracy. In particular, it was shown that target variations, articulations, and various operating conditions are problematic for the template-based ATR approach because this approach relied heavily on correlation templates. In a sense, the template-based approach works best when thousands of target templates are provided. Recent deep learning techniques overcame many of the shortcomings of the template-based approach. However, ATR technology with reduced a false alarm rate (FAR) is very important for precision target engagement. Along with advanced sensors (high resolution, multiple polarizations, etc.) and AI/ML technology, the foundation of the imaging scene may provide additional information to reduce FAR.

It is important that researchers of this topic have significant experiences in SAR imaging (two-dimensional (2D) and 3D imaging), layover issue, moving target signature, radar clutter mitigation, and deep learning-based target classification. Understanding SAR datasets such as the Gotcha radar data from the Air Force Research Laboratory (AFRL), moving and stationary target acquisition and recognition (MSTAR) datasets, and implementing deep learning techniques to MSTAR targets will be helpful. As needed, the Government will work with the performer to find relevant synthetic and measured datasets.

PHASE I: Research, develop, and demonstrate concepts for deep learning and scene geometry aided (SGA) ATR that contribute to reducing false alarms.

PHASE II: Implement geometry-aided ATR algorithms using synthetic aperture radar datasets and imaging scenes. Evaluate performance of SGA ATR and quantify false alarm reduction.

PHASE III DUAL USE APPLICATIONS: Transition SGA ATR technology by implementing the algorithms on relevant measured SAR datasets.

REFERENCES:

1. John F. Gilmore, "Knowledge-based target recognition system evolution," Optical Engineering 30(5), 1 May 1991. <https://doi.org/10.1117/12.55829>.
2. B. Bhanu, "Automatic target recognition: State of the art survey," in IEEE Transactions on Aerospace and Electronic Systems, vol. AES-22, no. 4, pp. 364–379, July 1986, doi: 10.1109/TAES.1986.310772.

3. U. K. Majumder, E. P. Blasch, and D. A. Garren, Deep Learning for Radar and Communications Automatic Target Recognition. Norwood, MA, USA: Artech House, 2020.
4. Timothy D. Ross, Steven W. Worrell, Vincent J. Velten, John C. Mossing, and Michael Lee Bryant. “Standard SAR ATR evaluation experiments using the MSTAR public release data set,” Proceedings SPIE 3370, Algorithms for Synthetic Aperture Radar Imagery V, 15 September 1998.

KEYWORDS: Automatic target recognition (ATR), synthetic aperture radar (SAR), false alarm rate (FAR), deep learning, artificial intelligence/machine learning (AI/ML), scene geometry, knowledge-based ATR

TPOC-1: Tom Majumder

Phone: 571-557-2432

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OSD221-002 TITLE: Automatic Labeling of Multiple Target Synthetic Aperture Radar (SAR) Imagery for Automatic Target Recognition (ATR)

OUSD (R&E) MODERNIZATION PRIORITY: Artificial intelligence/machine learning (AI/ML), autonomy

TECHNOLOGY AREA(S): Information systems; sensors; electronics

OBJECTIVE: Develop novel algorithms for labeling multiple target classes in Synthetic Aperture Radar (SAR) imagery to expedite training of SAR Automatic Target Recognition (ATR) algorithms.

DESCRIPTION: The focus of this research will be the automatic labeling of multiple-target target classes in SAR imagery for deep learning-based SAR ATR. A critical first step for AI/ML-based target classification involves providing a large amount of labeled data to train deep neural networks (DNN). As of now, there is no automated approach to label the training data (i.e., multiple target input SAR imagery). Currently, after SAR data collection and image formation, data labeling is conducted manually. As a result, the development and deployment of AI/ML-based algorithms can be greatly delayed. For each data collection or mission, labeling thousands of images manually is costly in terms of time and money. Hence, research should be conducted to develop novel algorithms to expedite the labeling process.

Currently, some research efforts attempt to apply active learning techniques to label single targets in SAR imagery (i.e., an image chip). One approach is a graph-based technique that labels a few images covering multiple target types, learns the features, and applies these features to label unlabeled imagery. This technique, sSemi-supervised learning (SSL), shows some success. Researchers also tried other approaches such as Core-set to label non-radar imagery.

The critical issue is that if a SAR image contains multiple targets multiple targets, which can be vehicles, bright vegetation, buildings, or unknown clutter, making labeling each detected object a difficult problem. Moreover, if the targets are heterogeneous in size, detection and labeling is further complicated. The goal of this research is to develop automated labeling algorithms that can label multiple classes of target without a human in-the-loop.

Research in this area requires significant experience in SAR imaging (2D, 3D imaging), clutter reduction, constant false alarm rate (CFAR) based detection, region-based detection, only-look-once detection, and deep learning-based target classification. An understanding of SAR datasets such as the AFRL Gotcha radar data, Moving and Stationary Target Acquisition and Recognition (MSTAR) dataset, and implementation of various deep learning techniques to MSTAR datasets will also be helpful. As needed, the government will work with the performer to find relevant synthetic and measured datasets.

PHASE I: Research, develop, and demonstrate an automated algorithm framework to label multiple target classes in radar imagery. Provide a baseline technique to automatically label multiple target classes in the open (separable targets surrounded by benign clutter such as cut grass, desert, etc.) in SAR imagery.

PHASE II: Implement automated SAR image labeling for complex targets scenarios. Evaluate performance of labeling and performing ATR on targets embedded in complex clutter (e.g., trees, etc.) using relevant datasets. Demonstrate an end-to-end ATR system that include the automated labeling of multiple target classes in SAR imagery, training, testing and ATR classification.

PHASE III DUAL USE APPLICATIONS: Adapt algorithms from Phase II to other mission relevant datasets.

REFERENCES:

1. Z. Meng, E. Merkurjev, A. Koniges, and A. L. Bertozzi, "Hyperspectral image classification using graph clustering methods," *Image Processing On Line*, vol. 7, pp. 218–245, 2017.
2. K. Miller, H. Li, and A. L. Bertozzi, "Efficient graph-based active learning with probit likelihood via Gaussian approximations," *arXiv preprint arXiv:2007.11126*, 2020.
3. C. Garcia-Cardona, E. Merkurjev, A. L. Bertozzi, A. Flenner, and A. G. Percus, "Multiclass data segmentation using diffuse interface methods on graphs," *IEEE Transactions on Pattern Analysis and Machine Intelligence*, vol. 36, no. 8, pp. 1600–1613, 2014.
4. U. K. Majumder, E. P. Blasch, and D. A. Garren, *Deep Learning for Radar and Communications Automatic Target Recognition*. Norwood, MA, USA: Artech House, 2020.
5. O. Sener, Silvio Savarese, "Active learning for convolutional neural networks: A core-set approach," *ICLR* 2018.

KEYWORDS: Automatic target recognition (ATR), synthetic aperture radar (SAR), data labeling, active learning, deep learning, artificial intelligence/machine learning (AI/ML), constant false alarm rate (CFAR)

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OSD221-003 TITLE: Rapid Object Detector Development from Limited Labelled Data

OUSD (R&E) MODERNIZATION PRIORITY: Artificial Intelligence / Machine Learning

TECHNOLOGY AREA(S): Information Systems Technology- Modeling and Simulation Technology; Computing and Software Technology

OBJECTIVE: Develop methods and science to rapidly produce object detectors for overhead imagery starting from a limited pool of hand-labeled data.

DESCRIPTION: NGA utilizes deep learning detectors to automatically find objects in overhead satellite imagery. Creating machine learning datasets for overhead imagery is particularly challenging and expensive because the area of each image is typically large, the total number of objects present in each image can be enormous, and the number of unique classes of objects is likewise very large. Lacking the benefit of existing large, labeled datasets of overhead imagery, detector developers often train a rudimentary detector beginning with a small pool of hand-labeled data. This initial detector is used to locate additional object examples in new, unlabeled imagery that are then confirmed by a human reviewer. These new, confirmed detections are then added to the original training data, together with (confirmed) incorrect detections serving as negative training examples in an iterative process sometimes referred to as bootstrapping.

This procedure has many flaws, including bias induced by a poor choice of the initial pool of labeled data and inefficient use of labeler time spent confirming correct but uninformative detections. One often overlooked concern is that the initial detector, and those improved iterative versions, may never be informed by the undetected false negatives, where an object of interest (OOI) has failed to be detected and hence fails to be added to the corpus of confirmed-positive training data. Indeed, undetected OOIs (false positives) effectively become unintentional incorrect negative training data, ensuring that the resultant detector algorithm will never find these objects. Despite these weaknesses and inefficiencies, this iterative bootstrapping method often produces effective and useful detectors that have value that exceeds the cost of developing exhaustively labeled and vetted training, test, and evaluation datasets.

NGA welcomes proposals for methods to improve this bootstrapping procedure and investigatory science to quantify the limitations introduced by undetected false negatives unintentionally introduced as negative training examples. Methods employed may include, but are not limited to, active learning [1] or semi-supervised learning [2]. Proposals should detail which publicly available datasets of labeled overhead electro-optic (EO) imagery are to be utilized in this work. Non-published datasets can also be proposed, but must be provided as a deliverable to the Government without restriction. Proposers should include a detailed explanation of metrics intended to show performance of both detectors and the quality of their resultant bootstrapped datasets.

PHASE I: Proposers will develop a bootstrapping process to create object detectors on EO satellite imagery, model the efficiency of that process, and theoretically quantify the impact of unintentional false negative detections on detector performance. As part of this process, proposers shall produce an unclassified, bootstrapped labeled data set from unlabeled satellite imagery provided as Government-furnished information. Proposers may additionally expand on existing labeled datasets to include new object classes that were not included in the original dataset labeling. Any datasets developed under Phase I shall be provided to the Government as a deliverable without restriction.

PHASE II: Proposers will refine their bootstrapping methodology and evaluation techniques resulting in a practical system as a deliverable. Focus should be on the acceleration and efficiency of the process, while minimizing the need for human-assisted review of iterative detector results without compromising

detector performance. Any datasets developed under Phase II shall be provided to the Government as a deliverable without restriction.

PHASE III DUAL USE APPLICATIONS: Follow-on activities are expected to be aggressively pursued by the offeror, namely, in seeking opportunities to create object detectors for a variety of imagery applications quickly, efficiently, and cost effectively.

REFERENCES:

1. Active learning: <http://burrsettles.com/pub/settles.activelearning.pdf>.
2. Semi-supervised learning: <https://arxiv.org/abs/2103.00550>.

KEYWORDS: Land use, land cover, land use change, remote sensing, computer vision, machine learning, deep learning, segmentation

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